up of the iron into simpler constituents? Mr. Lockyer went on to state that the probability that the elements are so broken up by the intense heat of the lower regions of the solar atmosphere is increased by finding that many of the lines seen in the lower regions are common to more than one element. He did not believe that the bright lines seen at the beginning and end of totality which are frequently spoken of as belonging to the reversing layer correspond to the dark lines of the Frauenhofer spectrum. In witnessing another total eclipse he should concentrate his attention on two of the basic iron lines, and note their behavior at the instant of totality.

Mr. Ranyard said: It is some years since we have seen Mr. Lockyer at a meeting of the Society. I am glad to see him here again, not only for the sake of the very eloquent lecture which he has given us, but also because of the influence which a Society like this is likely to have on those who read papers before it. It gives an opportunity of criticising theories and of asking questions, which is no doubt beneficial to the person who brings the theories forward. Mr. Lockyer has referred to a theory, which he has very widely discussed, with regard to the non-elementary nature of the elements, and the evidence to be derived from solar observations, I understood him to say that he would expect a greater heat to give us a less complex spectrum.

Mr. Lockyer: I never said anything of the kind.

Mr. Ranyard; I was about to say that the reverse appears to be the case. I hope that Mr. Lockyer will afterwards take the opportunity of explaining what he means. The spectrum of the photosphere is very complicated as compared with the spectrum of sunspots and prominences. If any fact needs dwelling upon with respect to the sun, it is the number of lines which cannot be matched with terrestrial elements, and the complication of the spectrum increases as you proceed downwards to the sun's limb; that is, as you proceed from cooler to warmer regions. In the region of the Corona, very few lines have been observed; that may be, it is true, because of their faintness; but with the exception of the hydrogen lines, the lines seen in the spectrum of the Corona, which, of course, is much cooler than the region of the chromosphere, do not correspond to known lines of any terrestrial element. There is, of course, an enormous field for study here; but the fact which I want to point out, is that you do not get a simplified spectrum in the sun with greater heat, and if the facts which Mr. Lockyer has referred to with regard to the common lines in the spectra of different elements are to be relied upon, it will not follow that the common lines correspond to the similar parts of the two elements, and that the other lines correspond to mere overtones, given out with greater heat. But I should like to ask Mr. Lockyer whether he has taken note of the observations of Professor Young, who has examined these lines common to two or more elements in the solar spectrum with great dispersion, and has found that they nearly all break up into double lines or groups of lines. I think out of fifty-seven lines all but four were shown to be thus broken up, and there was some doubt about these four.

Mr. Christie said: Similar observations to those which Mr. Lockyer has described with regard to the spectra of Sunspots have been made at Greenwich, and without adopting his theory, I may say that our observations agree with those which have been made by Mr. Lockyer. We have not confined our attention merely to the iron-lines which are thickened in the spot spectrum. But we perfectly confirm what Mr. Lockyer says, namely that in the spectrum of one spot there is one group of iron-lines thickened, while in the spectrum of another spot, there will be an altogether different group affected.

TERRESTRIAL MAGNETISM.—The French Government are about to establish an observatory for terrestrial magnetism at Cape Horn.

## A NEW DISCOVERY IN PHOTOGRAPHY.

At the last meeting of the Photographic Society of Great Britain, Mr. L. Warnerke described the discovery he has recently patented. The discovery he said consisted in the fact that a gelatine plate submitted to pyrogallic acid became insoluble in those parts acted upon by light, exactly in the same way as gelatine was acted upon by chromic salts, the insolubility being in proportion to the amount of light and the thickness of the gelatine. This property he proposed to utilize in various ways. The drawback in the ordinary gelatine process was that unless the exposure were very accurately timed there was considerable danger of over-exposure, and, as intensification was very difficult, pictures by the gelatine process were often inferior to those by collodion. By the new process he was, however, able not only to intensify, but also to overcome the drawbacks arising from over-exposure. The latter he effected by using the emulsion on paper. He had found that no matter how much the paper was over-exposed the picture—provided the developer was restrained sufficiently—was not injured, while in the case of the emulsion on glass there was not only halation of the image, but a reversal also. The transfer of the image from paper on to the glass was a very easy matter. The paper was immersed in water and placed in contact with a glass plate. The superfluous moisture was removed by a squeegee, and the paper could then be stripped off, leaving the tissue on the glass. Hot water was then applied, which dissolved all the gelatine not acted on by light, together with the free bromide or soluble salts, and the image was left upon the glass in relief. Intensification he effected by mixing with the emulsion a coloring non-actinic matter, which was not affected by silver. Aniline colors he had found answered the purpose, and in that way special emulsion for special purposes could be prepared. That method of preparation he thought would be especially suitable for magic-lantern slides. He claimed for his discovery that by it relief could be obtained far more easily than by the ordinary bichromatised gelatine, and therefore it was especially suitable for the Woodburytype process. By mixing emery-powder with the emulsion it was rendered fit for engraving purposes, and by a combination with vitrified colors the image could be burnt in and so was adapted for enamels. In the ordinary methods of producing enamels from carbonised gelatine the latter, from the difficulty of burning it without the formation of bubbles, was a great source of trouble. By using a suitable emulsion, however, so little gelatine might be employed that this drawback was overcome. The process could also be adapted for collotype printing. In the course of his remarks, Mr. Warnerke demonstrated the removal of a gelatine picture produced by his method from paper on to glass, and showed that the mere immersion and washing in hot water fixed the picture by the dissolving of the gelatine unacted upon by light, which thus carried away the free bromide of silver. In conclusion, he stated that the sensitive paper could be used in the camera in lengths wound on rollers, and exhibited a camera which he had made for the purpose.

Captain Abney, after some remarks in reference to halation and reversal of the image, remarked that in the production of enamels by Mr. Warnerke's process there was some danger of the silver producing the well-known yellow colour which spoilt so many vitrified photographs. The discovery made by Mr. Warnerke was a most important one, and in regard to Woodburytype, really opened up quite a new era. Mr. W. S. Bird endorsed Captain Abney's remarks as to the value of the process. To be able to produce gelatine negatives without the fear of the yellow stain was a great boon, and the only point was whether photographers would take the trouble and risk in the necessary transfers. As to its adaptability to Woodburytype, there could not be the slightest doubt. The great difficulty was to obtain the necessary relief, and he knew of a company which had recently gone to a great expense to fit up the necessary machinery, when Mr. Warnerke was able to give them what they wanted at a merely nominal cost.

Mr. T. Sebastion Davis also referred to the importance of the discovery, and suggested that by the use of the emulsion on paper a landscape might be photographed in which the clouds and the foreground might be rendered with equal truth, instead, as was too often the case, of the sky

being over-exposed. Mr. T. Bolas inquired whether Mr. Warnerke had tried adding bichromate of potash to his emulsion. The addition of bromide of silver in the case of a carbon print was supposed to increase its sensitiveness, but whether it did so he could not say. Mr. Warnerke in the course of his reply, said he had not found the yellow colour spoken of by Captain Abney, in the enamels which he had made. It was possible to eliminate all the silver by the use of ferric salts. With regard to Mr. Davis's suggestion, he was afraid he must throw cold water upon it, for he did not think it could be realized unless he used a developer for the clouds different from that used for the foreground. He had not tried bichromate of potash as mentioned by Mr. Bolas.

## ESTIMATION OF FAT IN MILK.

The plan I adopt is as follows :—10 grms. of milk are evaporated in a platinum boat (of suitable construction), to near dryness (to complete dryness if you wish to determine the total solids) in the water-bath ; the boat is now inserted into the extraction tube (which is plugged with a little cotton-wool and contains a stopper in the narrow part of the tube), and then connected to an upright Liebig's condenser. A small tarred flask is now fixed on to the end of the extraction tube (50 to 100 c. c. capacity) containing ether. The ether is evaporated by means of hot water, and when sufficiently condensed in the tube above, so as to completely cover the platinum boat, the stopper of the extraction tube is turned and the ether allowed to remain for about six hours or all night if convenient. All that now remains to be done is to cautiously open the stopper and allow the ether and oil to flow into the tarred flask ; boil the ether repeatedly until extraction is complete. Disconnect the flask, evaporate the ether dry, and weigh the oil. The platinum boat may also be taken from the extraction tube, dried in water-bath, and weighed, which will give the solids not fat, then ignited and weighed, and we have the ash. If there is any doubt in the mind of the operator that the ether has not been able to penetrate the residue, after there have been several extractions made, the boat may be withdrawn from the extraction tube, the residue detached from its sides by means of a small platinum spatula, and the whole again returned to the extraction tube, and the operation of extraction repeated. When the extraction has been conducted as described, there is no fear of any fat being left undissolved in the residue. The following duplicate analyses are the results I have just obtained from a sample of milk I have reason to believe is genuine or unadulterated. The amount of milk operated upon was 10 grms. Specific gravity, 1027·3.

| | | |
|---|---|---|
| Total solids..... | 10.2440 | 10.2448 |
| Fat..... | 1.9940 | 2.0001 |
| Solids not fat..... | 8.2500 | 8.2447 |
| Ash..... | 0.6940 | 0.6960 |

WILLIAM JOHNSON, F.I.C., F.C.S., &c.

## THE ELECTRIC RAILWAY.

One of the novelties at the Crystal Palace, London, on Easter Monday, was the opening of an electrical railway, constructed by the Société Anonyme d'Electricité of Brussels, on the Siemens system. On the upper terrace of the Palace grounds, overlooking the charming scenery of Sydenham, a miniature circular line of railway, consisting of three lines of metals, has been laid down, surrounding one of the ornamental ponds, and a small wooden hut erected beside it as a passenger station. On this railway, which is about 300 metres in length, and has a gauge of about 50 centimetres, or 19 inches, between the outer rails, stands the electrical locomotive. Its length is about four feet ; its breadth about a metre ; its height about as much, and its weight some three-quarters of a ton. It is, in fact, a Siemens dynamo-electric machine, neatly boxed in, and mounted on a truck with four metal wheels, and provided with a break and alarm bell for its control by the man in charge. A stationary engine of about eight horse-power nominal, in a shed about thirty yards from the railway line, drives a stationary dynamo-electric machine, from which the electro-motive current is primarily obtained. Two wires are connected with this fixed dynamo-machine. By one of them the current flowing out is conveyed to the mid-rail of the railway, to which it is attached by an iron plate bolted on. The second or return wire is attached to the exterior rail of the railway. The mid-rail is supported upon wood blocks, and is thus in a certain degree insulated. Beneath the electrical locomotive a brush of iron wires sweeps the mid-rail, and the electrical current is thus taken up into the locomotive, where it passes through the mounted Siemens machine within it, the large bobbin of which is thereby caused to revolve, and the current passing away by the wheels of the truck to the exterior rails of the road, is conveyed back to the stationary dynamo-machine. As the current thus circulates, and the bobbin of the mounted machine revolves, it drives the four wheels of the truck as the locomotive moves on, hauling after it a load of nearly three tons with ease at the speed we have named.

## NOTES.

INTERNAL DISCHARGES OF ELECTRIC CONDENSERS.—B. Villari.—The author's conclusions are that the heat evolved by the internal discharge may be neglected in case of feeble discharges; beyond certain limits it manifests itself and increases very rapidly with the discharges themselves ; thus the first means to augment this internal heat is to make use of jars charged to a very high potential. The internal discharge is sensibly augmented if the exterior spark is produced between two small balls of 20 to 30 mm. in diameter ; it decreases, on the contrary, by almost one-half if the spark is taken from a point and one of the balls. The inverse is the case for the heat produced by the external exciting spark. For a given charge the internal discharge increases if the inner coating of the jar is diminished.

RESEARCHES ON THE CHANGE OF STATE IN THE NEIGHBORHOOD OF THE CRITICAL POINT OF TEMPERATURE.—L. Cailletet and P. Hautefeuille—The authors remark that near the critical point there are witnessed for very slight variations of temperature, phenomena which have led Andrews to regard the gaseous and the liquid states as distant terms of one and the same state of matter, which may pass from one to the other by a continuous series of changes. It is impossible to know what is the state of the matter which gives rise to the moving and wavey striæ which displace each other above the mercury on operating in the vicinity of the critical point. A slow decrease of pressure often shows if a tube is filled with a liquid or a gas, for in the latter case the release gives rise to a general mist and to liquid drops ; but this procedure furnishes no clue to the nature of these striæ. The authors have overcome this difficulty by coloring carbonic acid with the blue oil of galbanum. They have found that these undulating striæ dissolve the oil, and are consequently produced by liquefied carbonic acid. They conclude that matter does not pass by insensible degrees from the liquid to the gaseous state.

ON THE ACTION OF THE SELENIUM RADIOPHONE.—M. E. Mercadier observes that the sounds produced in the selenium receivers which he has studied result chiefly from the luminous radiations. The rays of the spectrum act from the limit of the blue, on the indigo side, as far as the extreme red, and even a little beyond the red. The indigo, violet, and ultra-violet rays are without perceptible action in the conditions under which he has experimented. The maximum effect is always produced in the yellow portion of the spectrum. Radiophones with glass tube-receivers containing air, in contact with a smoked surface, give a different result, the action being principally thermic.—*Comptes Rendus.*

LAW RELATING TO CABLES.—*L'Electricité* says that there is some idea of appointing a commission to inquire into the state of international law relating to submarine cables. The Minister for Foreign affairs in France, M. St. Hilaire, has stated that, in case the forthcoming Congress of Electricians should arrive at any decision on the subject, he will send a circular to the various Governments suggesting the holding of an international conference.